

# Lecture Module - Electrical Signals

ME3023 - Measurements in Mechanical Systems

Mechanical Engineering

Tennessee Technological University

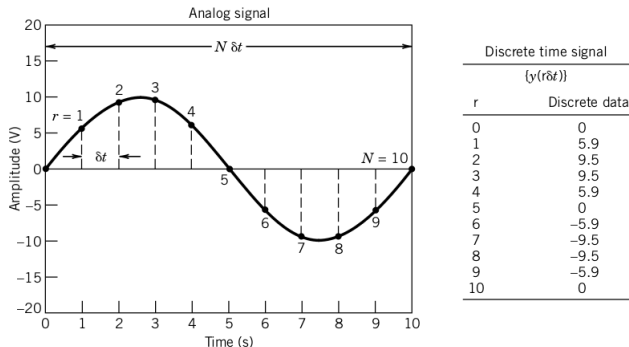
## Topic 3 - Sampling and Aliasing

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- Sampling
- The Aliasing Phenomenon
- Example by Hand
- MATLAB Example
- Activity

# Sampling

... A discrete time signal usually results from the sampling of a continuous variable at repeated finite time intervals. ...



# Sampling

some reference

# The Aliasing Phenomenon

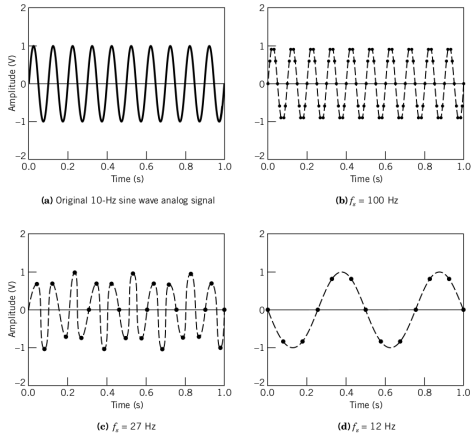


Figure: Theory and Design for Mechanical Measurements Ch. 7

# Example by Hand

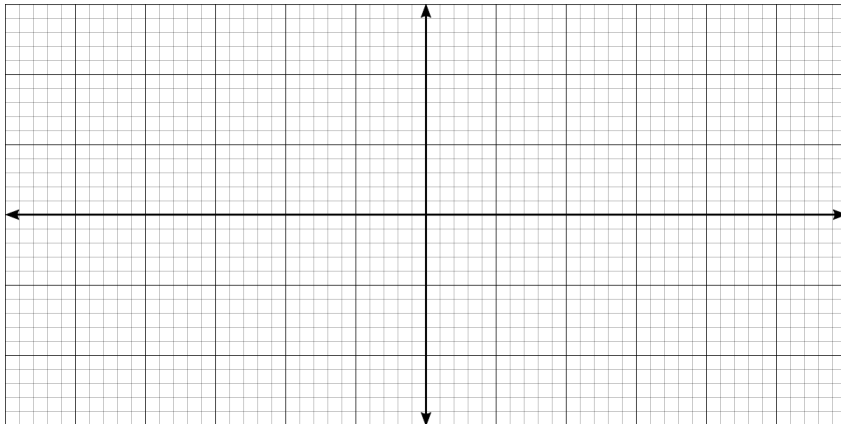


Image: T.Hill

# Example by Hand

some reference

# MATLAB Example

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% ME3023 - Tennessee Technological University  
% Tristan Hill - October 10, 2019 - April 14, 2021  
% Data Acquisition Topic 3 - Sampling and Aliasing

```
clear variables; close all; clc
```

```
% simulate a continuous signal
```

```
A1=5; f1=3;
```

```
w1=2*pi*f1;
```

```
dt_sim=0.001; t_stop=6;
```

```
t_sim=0:dt_sim:t_stop;
```

```
y_sim=A1*sin(w1*t_sim);
```

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# MATLAB Example

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```
% simulate sampling the signal
dt_sam = 0.3;
t_sam=0:dt_sam:t_stop;
y_sam=A1*sin(w1*t_sam);

% show the figure
figure(1); hold on
plot(t_sim,y_sim,'-',t_sam,y_sam,'o')
axis([0 t_stop -1.2*A1 1.2*A1])
grid on
```

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# Activity

## Activity: Sampling Demonstration

Write a MATLAB program to accomplish the following:

- 1 Plot a sinusoidal signal  $y(t) = A \sin(\omega \cdot t) = A \sin(2\pi f \cdot t)$  with an amplitude  $A = 10$  (units) and frequency  $f = 1000$  (Hz). This is the *ideal signal* source.
  - Include axis labels and gridlines.
  - Choose amplitude and time scales so that 15 to 20 periods of the waveform are shown.
- 2 Simulate the sampling of the signal by plotting the same function with a reduced time step. Plot the sampled signal on the same figure. Use a different marker and include a legend to differentiate the signals.
- 3 Use your code to determine the minimum sampling frequency required to measure the following quantities (note: use the sampled signal only, the *ideal signal* is not accessible).
  - Frequency of the *ideal signal*
  - Amplitude of the *ideal signal*

Deliverables: Submit your MATLAB code to the appropriate ilearn folder. If you work with a partner, include all names in the code. All group members must submit the assignment.

